EOSDIS Core System Project

Prototyping and Studies Plan for the ECS Project

May 1994

Hughes Applied Information Systems, Inc.
Landover, Maryland

Prototyping and Studies Plan
for the ECS Project

May 1994

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SUBMITTED BY

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. Changes to this document also require Government approval prior to acceptance and use. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

This document is under ECS Project Configuration Control. Any questions or proposed changes should be addressed to:

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1. Introduction

A prototype is a working model representing a subset of a system's functionality that is comprised of hardware and/or software components which may or may not be used as part of the final deliverable system. The purpose of prototyping is to test and evaluate alternative concepts, approaches, or implementations (which may involve newly developed technology) of ECS functions. Prototyping is a proof-of-concept technique directed toward the validation of requirements, the product design, and interfaces, before commitment to the final product. It embodies all three quality techniques: engineering, reviewing, and testing.

Studies are an analysis of a subset of the requirements, design or implementation of the ECS. The purpose of studies, in many cases, is to investigate an alternative requirement, design approach or implementation solution to be used in the development of the ECS. Studies on the ECS project may be followed by a prototype effort which provides a more in-depth investigation of the proposed alternative.

The ECS design is built on prototyping, modeling, simulation, and technology evaluation for rapid analysis of ECS requirements and risks. The ECS Systems Engineering Plan, Data Item Description (DID) 201/SE1, and the ECS Systems Implementation Plan (DID 301/DV1) describe the integral part prototyping and studies play in the ECS Project.

Prototyping and studies are fundamental components of the overall multi-track concept being used for the development of ECS and offer greater opportunity to solicit and incorporate user input from the science community. Prototypes and studies are used on the ECS project to:

- Evaluate the feasibility of a concept, process, or new products/technology
- Investigate potential new requirements
- Promote design evolution
- Converge user requirements with system functionality taking into account user sensitivities
- Investigate re-allocation of requirements
- Trade design and implementation alternatives
- Mitigate risks by prototyping prior to design commitment

1.1 Identification

This Prototyping and Studies Plan, Contract Data Requirement List (CDRL) item 052, whose requirements are specified in DID 317/DV1, is a required deliverable under the ECS Contract (NAS5-60000).

1.2   Scope

The Prototyping and Studies Plan describes the Identification, Selection, Execution/Evaluation, and Incorporation activities associated with all prototyping and studies that support evolutionary ECS development. The plan also includes the roles and responsibilities of government and contractor organizations in this process. Information about specific prototypes and studies, including descriptions and evaluation plans, are outside the scope of this document. Appendix A does, however, include a current list of recent prototypes and studies and how they relate to the potential benefits to the ECS architecture. This list is subject to change as requirements of the EOSDIS Project change.

1.3   Purpose

The purpose of the Prototype and Studies Plan is to provide a process which a person or organization can follow to take a prototype or study from idea through incorporation of results into the design and/or implementation of the ECS.

1.4   Status and Schedule

This version of the Prototyping and Studies Plan is submitted to the Government as an approval code 1 (DV1) document. At the Government's option, this document may be designated to be under full Government CCB control. No planned revisions are called for in the Contract Data Requirements Document, but changes may be submitted for consideration by Contractor and Government CCB under the normal change process.

1.5   Document Organization

This document is comprised of the following sections:

Section 1   Identifies the document and defines the scope, purpose, objectives, schedule and structure for the document.

Section 2   Provides a bibliographic reference list for the plan and discusses the relationship of the Prototyping and Studies Plan to other documents.

Section 3   Provides a brief description of the ECS architecture and describes the potential impacts to that architecture resulting from ECS prototyping and study efforts.

Section 4   Describes the roles and responsibilities of the government, ECS contractor team, and Science/User Community in Prototype and Study efforts.

Section 5   Defines how prototypes and studies are identified, selected, executed, evaluated, and how results are incorporated into the design of ECS.

2. Related Documentation

Figure 2-1, ECS Document Relationships, shows how the Prototype and Studies Plan fits into the overall ECS documentation tree. The associated arrows signify the increasing level of detail for the ECS design and implementation.
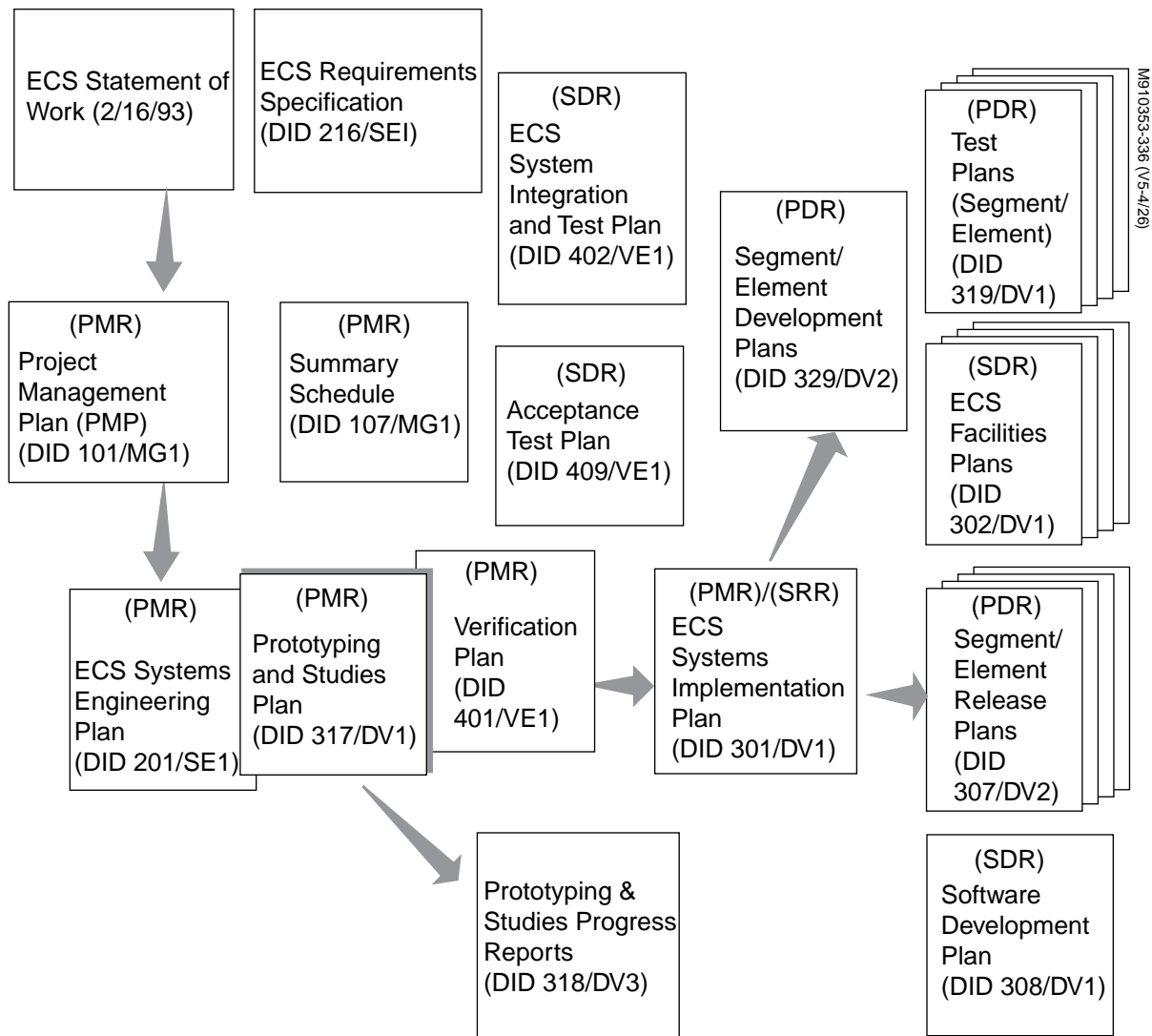
Figure 2-1. ECS Document Relationships

2.1   Parent Documents

As shown in Figure 2-1, the following documents are the parent from which this document's scope and content derive:

101/MG1   Project Management Plan

201/SE1   ECS Systems Engineering Plan

                                 EOSDIS Core System (ECS) Statement of Work (2/16/93)

2.2   Applicable Documents

The following documents are referenced herein and are directly applicable to this plan. In the event of conflict between any of these documents and this plan, the plan shall take precedence.

216/SE1   ECS Requirements Specification

329/DV2   Segment /Element Development Plans

307/DV2   Segment/Element Release Plans

107/MG1   Summary Schedule

318/DV3   Prototyping & Studies Progress Reports

308/DV1   Software Development Plan

2.3   Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding:

206/SE2   Version 0 Analysis Report

111/MG3   Monthly Progress Reports

193-00623   ECS Evolutionary White Paper

FB9404V2   Multi-Track Development for the ECS Project White Paper, March 1994

3. Potential Benefits to the ECS Architecture

This section of the document briefly describes the potential benefits of prototypes and studies on the current ECS architecture.

3.1 ECS Architecture

ECS is made up of the Flight Operations Segment (FOS), the Science Data Processing Segment (SDPS), and the Communications and System Management Segment (CSMS).

The purpose of the FOS is to provide a highly reliable, secure flight operations system that maximizes science data collection while protecting the health and safety of the instruments. The FOS consists of the Earth Observing System (EOS) Operations Center (EOC) and Instrument Control Center (ICC) elements, and the Instrument Support Terminal (IST) toolkits.

The purpose of the SDPS is to produce, archive, and maintain long term global science research products, allow searching of its holdings, and deliver ordered products.

CSMS is the ECS infrastructure that provides basic connectivity (within and between ECS sites, from ECS to other EOSDIS institutions, and from users to ECS) and overall ECS management. CSMS accomplishes this mission through its EOSDIS Science Network (ESN) and System Management Center (SMC) elements.

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4. Roles and Responsibilities

The following paragraphs define the roles and responsibilities of the government, the ECS contractor team, and the science and user community with respect to the identification, selection, execution/evaluation and incorporation of prototypes and studies into the ECS development process. The role of the Prototype Review Board is also described.

Figure 4-1, Prototypes and Studies Organizational Structure, shows the relationship between government, ECS contractor team, and the science community in supporting ECS prototype and study activities. Each of these organizations and key positions are described in the remainder of this section. The Prototype Review Board has responsibilities for reviewing advanced prototypes. Each of the three ECS Segments and the Science Office have both government and contractor managers. In addition to Segment and Science Office managers, the ECS contractor team also has a Technology Assessment Group, a Prototype Administrator, Prototype Leads and a Development Team Representative (DTR) for each prototype. The government has a Prototyping Manager, a Contracting Officer (CO), and a Contracting Office Technical Representative (COTR). The Prototype Evaluation Team consisting of government, contractor team, and science/user representatives rounds out the organization.

4.1 Government

4.1.1 Prototype Manager

The Prototype Manager maintains cognizance of all ECS prototype efforts through the review of Prototype Summary Reports provided by the ECS Prototype Administrator. In addition, the Prototype Manager is responsible for over-seeing all advanced prototypes. Advanced prototypes are described in paragraph 5.2. The prime responsibility is the appointment of Prototype Evaluation Team members including a chairperson. These appointments are required for each advanced prototype and study. The Prototype Manager is responsible for ensuring adequate user involvement in prototyping and study efforts affecting the science and user community use of ECS.

4.1.2 Contracting Officer/Contractor-Office Technical Representative

The NASA Contracting Officer (CO) or the Contract Officer's Technical Representative (COTR) has the responsibility of approving advanced prototypes when Work Breakdown Structure (WBS) 1.7 funding is required. The decision to approve or disapprove is based upon the recommendation provided by the Prototype Manager and the Prototype Review Board.
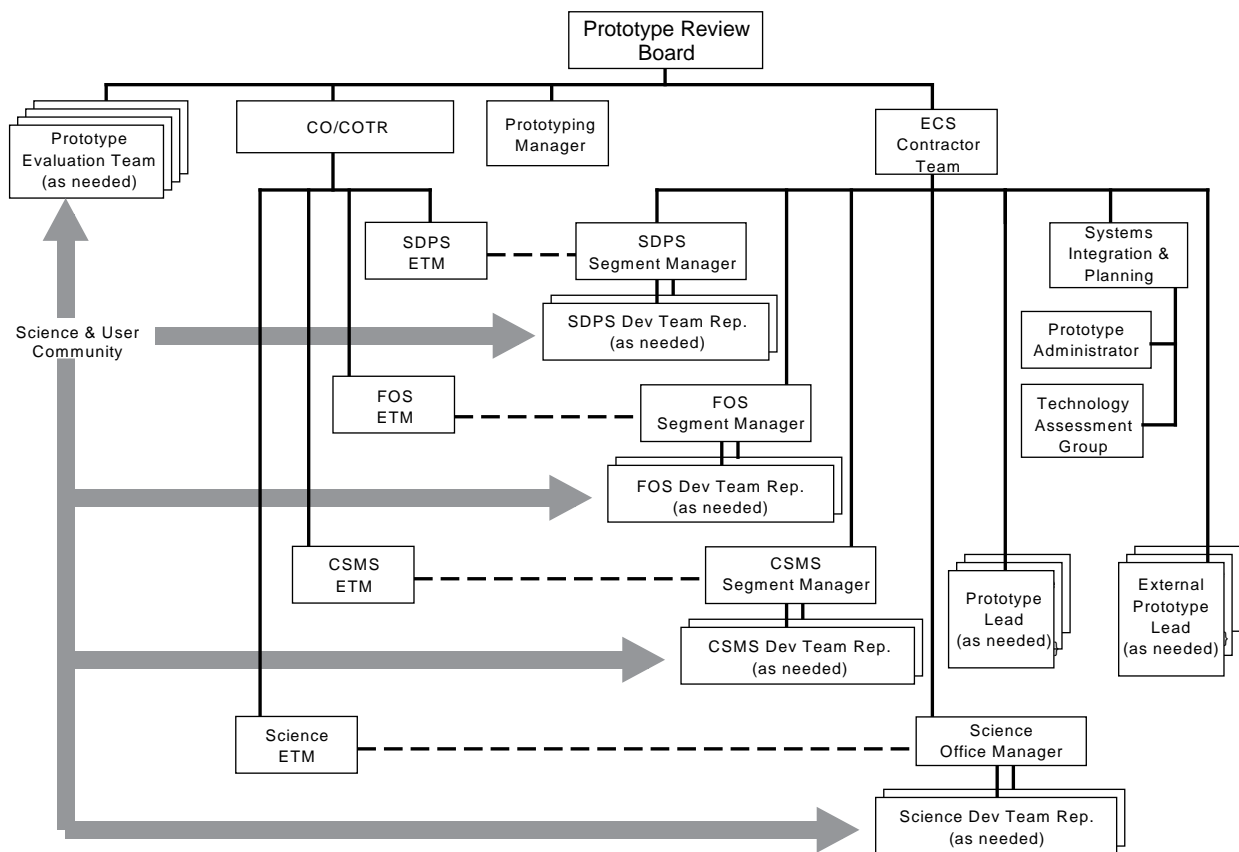
Figure 4-1. Prototypes and Studies Organizational Structure

4.1.3 ECS Technical Managers

The ECS Technical Managers (ETMs) provide the overall technical direction for all prototypes and studies funded by WBS x.3, and relating to the design and development of the segment for which they are responsible. This includes approval of the objectives, cost, schedule, evaluation criteria and Progress /Final Reports for the prototypes and studies. The ETM will approve the level of user participation in the evaluation of prototypes and studies affecting the design and development of their respective segment. The ETM approves the type of documentation required, within the guidelines specified in the Software Development Plan, required and the level of technical reviews necessary to successfully incorporate prototypes and studies into segment design and development. The ETM also advises the COTR on advanced prototypes. This includes recommendations on Configuration Change Requests (CCRs), incorporation of advanced prototype results into segment design, and level of participation from the science and user community that may be required.

4.2 ECS Contractor Team

4.2.1 ECS Segment Managers

The ECS Segment Managers initiate engineering and technical analysis prototypes relating to the design and development of their respective segment. They identify the Development Team Representative (DTR) within their segment, specify prototype/study goals and objectives, and are responsible for developing a cost and schedule profile using information provided by the prototype proposal (See paragraph 5.2.2). The ECS Segment Manager has approval authority for those prototypes/studies funded by all applicable work breakdown structure (WBS) funds other than those in WBS 1.7 and WBS x.3. Prototype/study efforts funded with WBS x.3 funds require approval of the ETM; WBS 1.7 funds require CO/COTR approval.

4.2.2 Development Team Representative

The Development Team Representative (DTR) serves as the primary advocate for each prototype/study effort. The DTR is a member of the ECS contractor team organization and is a member of the segment development team. This relationship ensures that prototype and study efforts are collaborated with the main-stream Segment development activities. It also provides the most effective means of incorporating results into the design and implementation of the segment. Primary advocacy includes validating the planned prototype and study approach. The DTR is the person held accountable for the success of the respective prototype or study. To this end, the DTR is responsible for providing status, as required, on his/her respective prototype.

Responsibilities also include soliciting user participation as required and playing a major role in the evaluation effort for that prototype or study. For advanced prototypes, the DTR is also a member of the Prototype Evaluation Team.

4.2.3 Technology Assessment Group

The Technology Assessment Group is responsible for maintaining cognizance of the state of the art in technology areas relating to the design and development of the FOS, SDPS, and CSMS segments. This is an on-going effort requiring proactive involvement inside and external to the ECS community. This information is made available to the DTRs, ECS Segment Managers and Prototype Leads to support the on-going ECS prototypes and studies.

4.2.4 Prototype Administrator

The Prototype Administrator is a member of the ECS Systems Integration & Planning organization that is responsible for tracking the status of all ECS prototyping and study efforts. This information is maintained in a prototype tracking database implemented using the Requirements Tracking Matrix (RTM) tool. This includes translating the prototype proposal data into the RTM prototype tracking database. The Prototype Administrator is also responsible for generating Prototype Summary Reports, as required, and making them available electronically via the Electronic Data Handling System (EDHS). The summary reports will also be presented at the Annual Capabilities Requirements and Technology Review (CRR).

4.2.5 Prototype Lead

The Prototype lead is a member of the ECS contractor team organization and is responsible for the day-to-day management of the engineering and technical analysis prototypes or studies. This includes keeping the effort on schedule and ensuring that adequate resources are available. Status of the prototype or study is reported to the development team representative on a regular basis. In most cases where the required prototype/study effort is small, the Prototype Lead will also be the Development Team Representative. In those cases where the ECS contractor team uses an external organization to lead a prototype effort, the Prototype Lead will be member of that external organization while the DTR will be a member of the ECS contractor team. All external organizations must meet procurement eligibility criteria.

4.3 Science User Community

The Science User community provides feedback and evaluations on some studies and prototypes. For some advanced prototypes, this feedback will occur through direct participation on Prototype Evaluation Teams. For other prototype and study efforts, this feedback will be accomplished through the Development Team Representatives.

4.4 Prototype Review Board

The Prototype Review Board meets as required to recommend approval or disapproval of advanced prototypes to the CO/COTR. This board acts as a screening process for advanced prototypes and recommends Evaluation Team members. The board will review proposed advanced prototypes using the proposal information generated from the RTM prototype tracking database and detailed planning information provided by the DTR. Inputs from the potential DTRs and Prototype Lead will be solicited, as necessary, in reviewing the proposals. Board recommendations will be based on the selection criteria defined in paragraph 5.3. Results of the board will be documented in the RTM prototype tracking database.

4.5 Prototype Evaluation Team

The Prototype Evaluation Team, selected by the Prototype Manager, is responsible for determining the success of advanced prototype and study efforts. This activity must be performed using a pre-defined set of evaluation criteria. All products of the prototype or study must be considered. Each Prototype Evaluation Team will have a Team Leader, also chosen by the Prototype Manager. Additional membership on the team may come from the Segments, Maintenance and Operations, the Technology Assessment Group. The Team Leader is responsible for ensuring adequate user involvement in the evaluation process. In many cases, this may require user representatives on the evaluation team.

5. Prototyping And Studies Process

Prototyping and project specific studies are an important aspect of ECS Systems Engineering. This section shows the process of how prototypes and studies are identified, selected, executed, evaluated, and how results are incorporated back into the design and implementation of the ECS.

5.1   ECS Development Process Overview

Figure 5-1, ECS Multi-track Development Life Cycle, shows how prototyping relates to multi-track development within the ECS evolutionary development cycle. The evolutionary development cycle, described in the ECS Systems Engineering Plan, is driven by challenges or risks, and the need to resolve these uncertainties. Multi-track development provides development of systems with a stable set of requirements on a formal development track while systems with requirements rapidly changing to adapt to user needs are implemented using an incremental development track. The formal development track is characterized by a complete tree of requirements specifications, formal reviews at major milestones, and a single waterfall of phases leading to a formal release. The incremental development track is characterized by multiple iterations of requirements, design, and implementation with frequent user evaluations. The documentation and milestones are less formal than the formal development track.

Prototyping and study activities do not normally produce products destined for formal delivery and are not included with the formal and incremental development track deliveries. The results and status of all prototypes are distributed via the ECS Data Handling System (EDHS), and some actual prototypes may be included as part of an evaluation package to allow for broader user involvement.

5.2   Prototyping and Study Characteristics

Before the details of the prototyping process are described, the different types of prototypes and studies must be identified. Prototypes and Studies supporting the design and development are classified as one of the following:

- Advanced Prototypes and Studies

- Technology Analysis Prototypes and Studies

- Engineering Prototypes and Studies

Technology analysis and Engineering prototypes and studies in many cases are part of the normal development process. Resources, funding and schedule are already in the ECS development process. Advanced prototypes as well some technology analysis and engineering prototypes and studies may require additional funding or a reallocation of resources. The next three paragraphs describe the specific characteristics associated with each class.

Formal Development

Which track ?

ICDs

Integration

Planning

Incremental Development

Increment

Increment

Increment

EP

EP

EP

Evaluation Packages

Prototypes (optional)
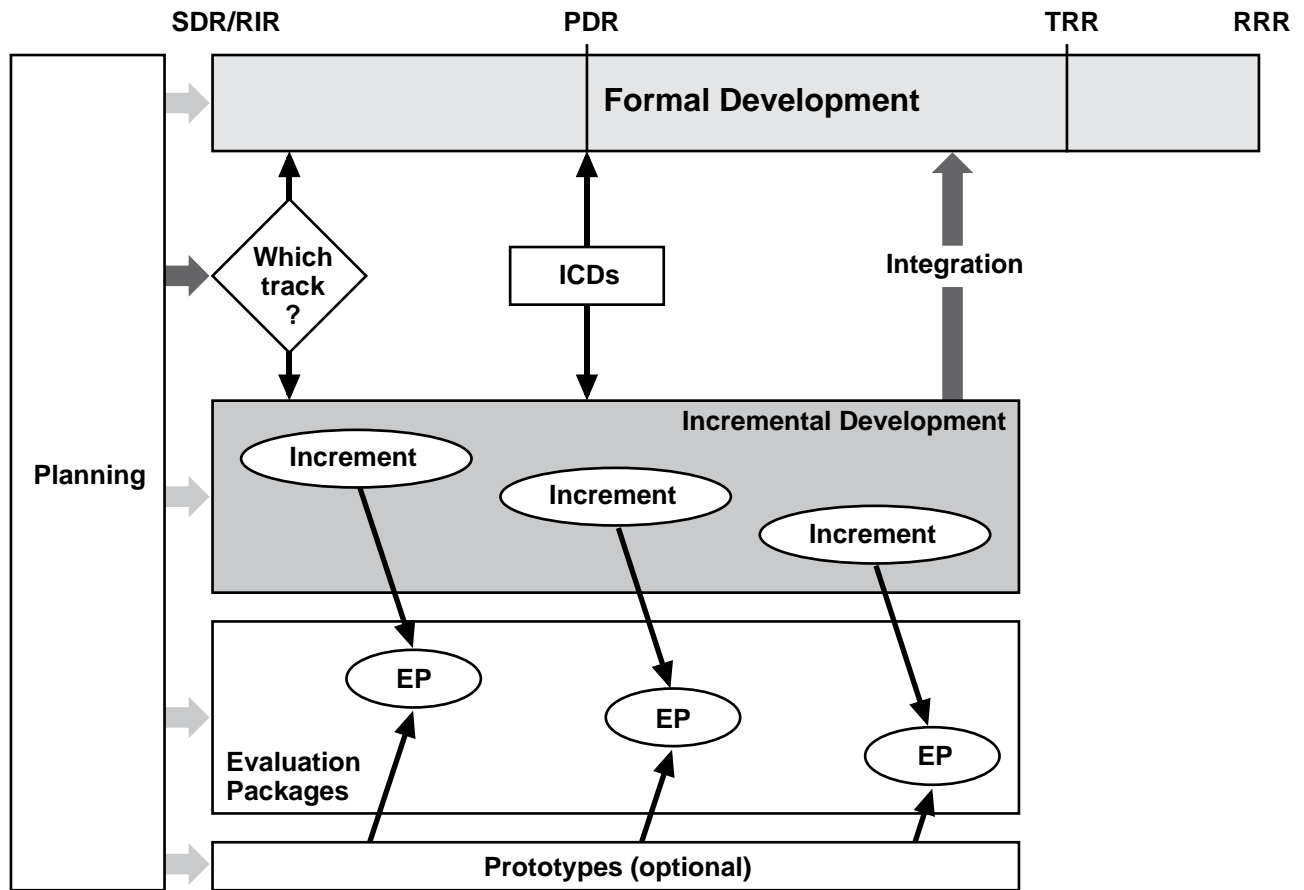
Figure 5-1. ECS Multi-Track Development Life Cycle

5.2.1 Advanced Prototype and Study Characteristics

Advanced prototypes and studies are used to evaluate the feasibility of a new or alternative concept, with the focus on investigating the potential of new requirements or alternative implementations of the ECS. They require significant government involvement to approve, evaluate and incorporate results. In many cases, the user and/or scientist will play a direct role in the evaluation of the advanced prototype. The results of advanced prototypes will generally impact the requirements phase of the ECS development cycle.

Advanced prototypes are developed in partnership with varying levels of ECS segment and external organizations. These external organizations include commercial labs, universities and other government agencies. Advanced prototypes should not be constrained by the desire to easily incorporate results back into a specific ECS release. Advanced prototypes should be free to explore a wide range of alternative designs. The goal of advanced prototypes is to explore potential significant improvement in ECS efficiency.

Because of the potential free-ranging nature of the advanced prototypes, the government and user community will play a key role in keeping these prototype and study efforts on track and productive.

5.2.2 Technology Analysis Prototype and Study Characteristics

Technology Analysis prototypes and studies are used to evaluate Commercial-Off-The-Shelf (COTS) products, shareware, other prototypes, and new technologies. Results are targeted to a specific delivery date or release. These prototypes and studies *test-drive* new technologies for inclusion in the ECS design. The results of these efforts provide an in-depth look at a particular technology and how it applies to the ECS design. Technology analysis prototypes generally impact the design phase of the ECS development cycle.
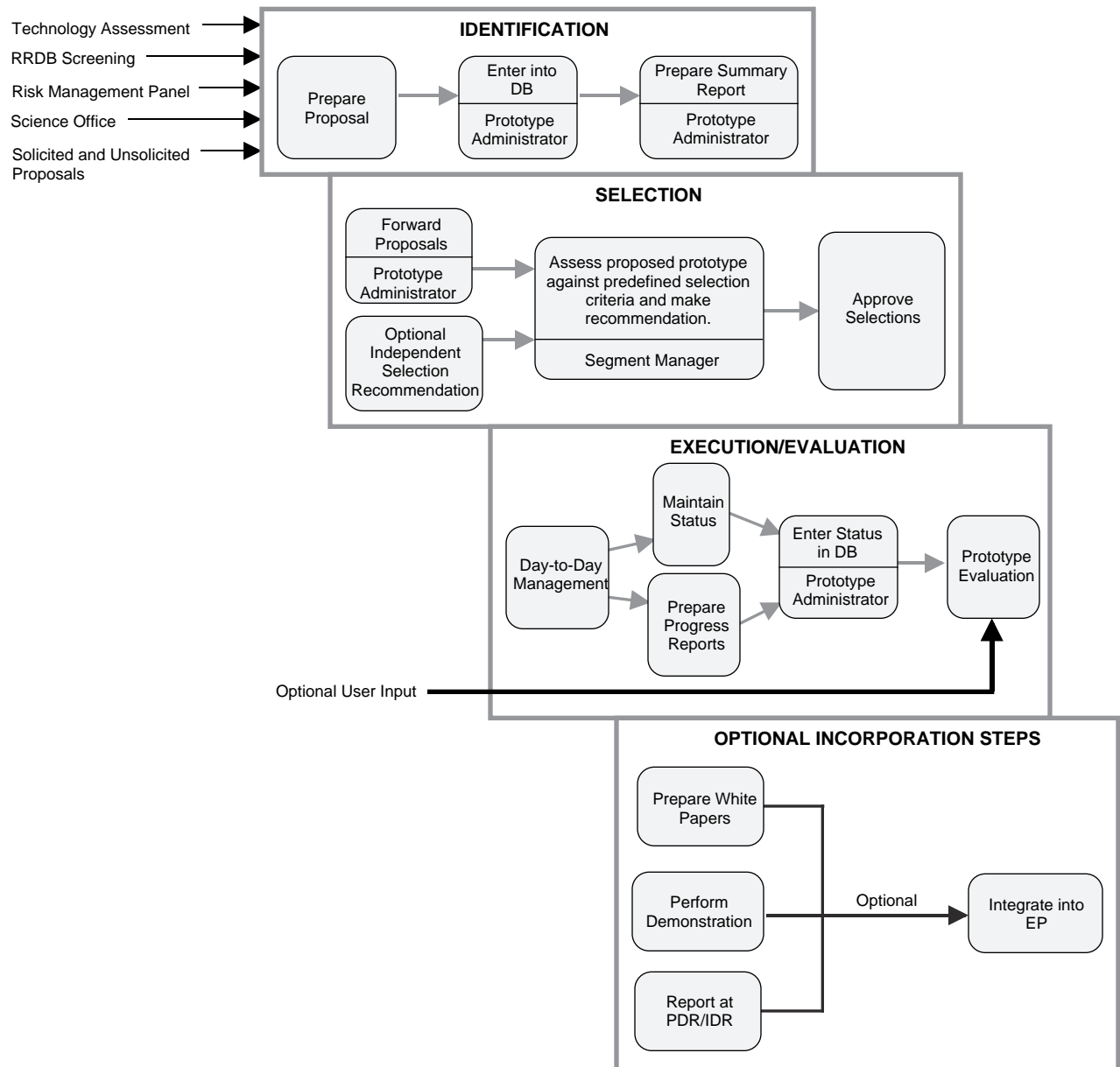
5.2.3 Engineering Prototype and Study Characteristics

Engineering prototypes and studies are used to enhance the ECS development cycle by minimizing cost and schedule or defining/mitigating design and performance risks. These types of prototypes and studies test the feasibility of a design or implementation concept. These prototypes are more conservative than advanced prototypes and are started early in the development cycle with the intention of producing results by specific delivery dates. Engineering prototypes include efforts to trade designs, incorporate user needs, converge requirements and consider design alternatives. Engineering studies may include the incorporation of external (to the EOSDIS Project) prototype efforts. Engineering prototypes generally impact the implementation phase of the ECS development cycle.

5.3 Prototyping and Study Process Overview

Figure 5-2, Prototypes and Studies Process, shows the identification, selection, execution/evaluation and incorporation of prototypes and studies for the ECS project. Identification is the process of proposing a prototype or study for implementation. Selection is the process of reviewing the prototype and study proposals for approval by the Prototype Review Board or ETMs. Execution/evaluation is the process of implementing the prototype and reporting on the progress of prototype activities to the project. Incorporation is the process of feeding results back into the design and implementation process in the most effective manner.

IDENTIFICATION

Technology Assessment

RRDB Screening

Risk Management Panel

Science Office

Solicited and Unsolicited Proposals

Prepare Proposal

Enter into DB
Prototype Administrator

Prepare Summary Report
Prototype Administrator

SELECTION

Forward Proposals
Prototype Administrator

Optional Independent Selection Recommendation

Assess proposed prototype against predefined selection criteria and make recommendation.
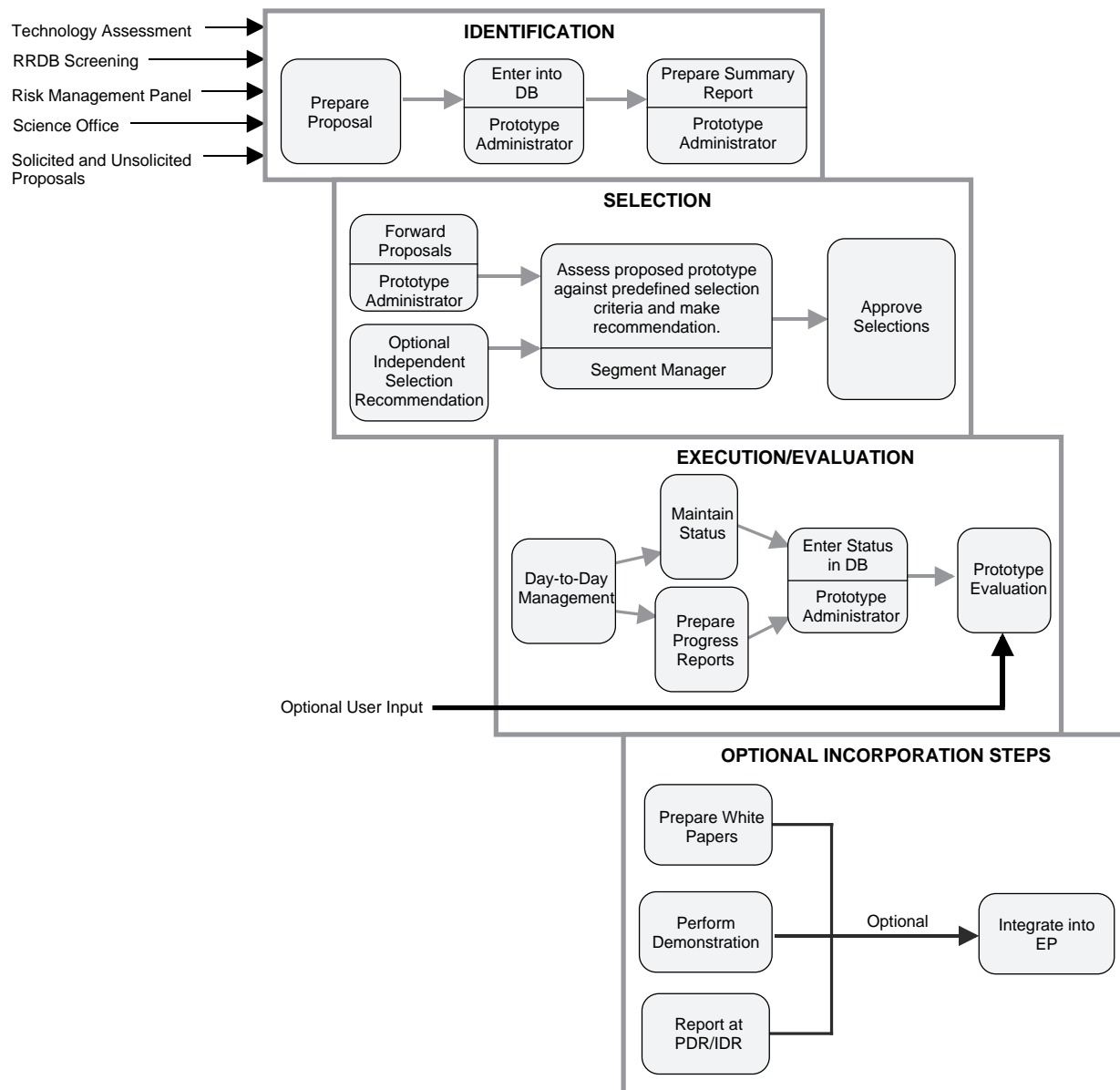Segment Manager

Approve Selections

EXECUTION/EVALUATION

Day-to-Day Management

Maintain Status

Prepare Progress Reports

Enter Status in DB
Prototype Administrator

Prototype Evaluation

Optional User Input

OPTIONAL INCORPORATION STEPS

Prepare White Papers

Perform Demonstration

Report at PDR/IDR

Optional

Integrate into EP

Figure 5-2. Prototypes & Studies Process

Figure 5-3, Advanced Prototypes & Studies Process, identifies the responsible organizations or personnel for processing advanced prototypes. Likewise, Figure 5-4, Technology Analysis & Engineering Prototypes & Studies Process Flow identifies the responsible organizations or personnel for processing technology analysis and engineering prototypes.

IDENTIFICATION

Technology Assessment →
RRDB Screening →
Risk Management Panel →
Science Office →
Solicited and Unsolicited Proposals →

Prepare Proposal
NASA, ECS Contractor, External

Enter into RTM DB
Prototype Administrator

Prepare Summary Report
Prototype Administrator

SELECTION

Forward Proposals
Prototype Administrator

Optional Independent Selection Recommendation
Science/User Community

Assess proposed prototype against predefined selection criteria and make recommendation.
Prototype Review Board and Prototype Manager

Approve Selections
COTR

EXECUTION/EVALUATION

Day-to-Day Management
Prototype Lead

Maintain Status
DTR

Prepare Progress Reports
DTR

Enter Status in DB
Prototype Administrator

Prototype Evaluation
Prototype Evaluation Team

Optional User Input →

OPTIONAL INCORPORATION STEPS

Enter Reqs into RRDB
DTR

Prepare White Papers
DTR

Perform Demonstration (Optional)

Report at PDR/IDR

Optional →

Integrate into EP

Figure 5-3. Advanced Prototypes & Studies Process

**Figure 5-4. Technology Analysis and Engineering
Prototypes & Studies Process**

5.4 Identification

Identification of ECS prototypes and studies will come from several sources within and external to the ECS project. These include:

- Technology Assessment
- Recommended Requirements Database (RRDB) Screening

- ECS Risk Management Panel
- ECS Science Office
- Solicited and Unsolicited Proposals (Internal and External to ECS)

A short proposal (one to two pages) is to be prepared by the organization or person proposing that a prototype and/or study be performed to support design and development of the ECS. This proposal is used to initiate a tracking mechanism in the prototype tracking database. This proposal is also the means in which for determining which prototype efforts are funded as part of the existing ECS contract or which require additional funding from the government. The proposal will include the following:

- Title - Identification Name of the prototype or study.
- Type - Prototype or Study.
- Category - Advanced, Engineering, or Technology Analysis.
- Status - Proposed, In progress, or Completed.
- Purpose - Intent of the proposed prototype or study showing how it relates to ECS.
- Objectives - Clear set of objectives for which the prototype or study is being performed. The objectives should identify any problems that are expected to be solved by the effort, and should be written in sufficient detail so that a clear set of evaluation criteria can be determined to assess success of the prototype.
- Approach - Identify which segment managers will be involved, who will perform the effort (e.g., ECS contractor team, government, subcontractor, external); what resources are required (e.g., hardware, software); and the general approach to be used (e.g., develop hardware, develop software, interviews, literature research); and how prototypes are to be evaluated.
- Evaluation Method - Proposed method of determining the success or failure of the prototype or study effort. This section must include the criteria against which the prototype or study will be evaluated.
- Key Risks Addressed - Any design or implementation risks that the prototype or study will aid in mitigating.
- Deliverables - Identify all documentation, hardware and software being developed as part of the proposed effort and cost of labor and materials/equipment per year.
- Documents - Reference any related documents that provide more detail about the prototyping effort.
- Funding - Indicate the preferred source(s) of funding: ECS Segment, ECS Segment Prototyping, or Engineering Support.
- Cost Estimate - Provide a cost estimate for estimated persons, hardware and software.

- Schedule - Identify major ECS milestones significant to the prototype or study. Include dates for the start and completion of the effort, delivery of products resulting from the prototype or study effort, and any other prototype milestones.

- Potential Impact - Describe how the results of the prototype or study will impact the requirements, design and/or development of the EOSDIS. Include a discussion on potential cost savings to the project.

- Prototype Lead

- Development Team Representative

The proposal will be submitted to the Prototype Administrator for processing. Appendix B contains a sample of the form to be used for the proposal.

5.4.1 Initiate Prototype and Studies Database Tracking

The status of all prototype efforts will be tracked in the prototype tracking database. Tracking starts with the proposal and ends with a negative disposition and withdrawal of the proposal or, if completed, with incorporation of results into the development process. The Prototype Administrator is responsible for entering the proposal data into the database. The Prototype Administrator is also responsible for maintaining up-to-date status of the prototypes and studies in electronic files via the EDHS. If a proposal is disapproved, the database will reflect this status and continue to maintain a record of the proposal to keep a complete historical record of all proposed prototypes and studies.

5.4.2 Prepare Prototype Summary Report

The database will provide the capability to produce an on-demand status of any ECS prototype and study. In addition, the database will be accessible by the ECS community via the EDHS. The Prototype Administrator is responsible for producing and distributing the Prototype Summary Reports to support the selection process.

5.5   Selection

The Prototype Administrator will forward Prototype Summary Reports and funding source to the appropriate selection review personnel to begin the selection process. For all prototype classes, the following checklist will be used as selection criteria:

- Are the objectives consistent with and within the scope of the requirements?

- Is the proposed prototype or study feasible in terms of cost, schedule, and resources required?

- What is the potential contribution to ECS?

- Does the prototype or study reduce risk?

- Does the prototype or study affect mission critical areas ?

- What is the source of funding? What is the priority of the proposed prototype with respect to other prototypes with the same funding source? Is the prototype cost effective?

- Are the Development Team Representative and Prototype Lead identified? Are they available? Do they advocate that this prototype effort be performed?

- What is the level of user participation required? Does the proposal include a plan to incorporate the necessary user input?

Approval of prototype activities is based on the funding source as indicated in Table 5-1, Prototyping Approval.

Table 5-1. Prototyping Approval

Prototype Funding Source	Approval Authority
ECS Contractor Engineering Support (WBS 1.7)	CO/COTR with recommendation from Prototype Review Board
NASA Headquarters	NASA Headquarters
EOSDIS	EOSDIS
Segment Prototyping (WBS x.3)	Segment Manager & ETM
Segment	ECS Segment Manager

The Prototype Administrator forwards proposals for advanced prototypes from the Prototype Tracking Database to the Prototype Review Board for consideration. The Prototype Review Board selects which advanced prototypes will be implemented based on recommendations from government and contractor team management and user community representatives. These recommendations are to be based on the criteria checklist defined above.

ECS "Tire Kickers" or independent data and payload panels may provide input into the selection process. The Prototype Manager will also approve the selection of advanced prototypes. Part of the selection process includes the approval of the list of participants to implement and evaluate the prototypes.

For engineering and technology analysis prototypes and studies, the Prototype Administrator forwards proposals from the Prototype Tracking Database to the appropriate Segment Manager for consideration. Segment Managers are responsible for selecting the engineering prototypes to be implemented and evaluated based on the criteria defined above. The NASA ETM for the applicable segment is responsible for approving the selections when WBS x.3 funds are involved. Otherwise, the ECS Segment Manager has approval authority.

5.6 Execution/Evaluation

Prototype development and study execution begins after approval by the appropriate approving authority as indicated in Table 5-1. Most prototypes and studies will be staffed with personnel from the ECS segment development organizations. Some will use organizations external to the ECS contractor team to perform the prototype and study activities. This may be accomplished

through the establishment of subcontracts and/or the retention of a consultant. The use of sole-source or competitive procurement subcontracts will be determined on a case-by-case basis. In all cases, the DTR for each prototype or study will be chosen from the segment organization which is most directly involved in the design decision being studied.

Because the ECS design process is always evolving, new prototypes and studies may be proposed or those currently planned may be modified or made obsolete, by the results obtained from engineering efforts, other prototypes and studies, or Version 0 activities. Successful development requires that the impacts resulting from these evolutionary development activities be fed back into the prototyping and study process. In some cases, studies are planned prior to prototypes in order to ensure that the prototype use the most effective methods. Re-evaluation takes place on a regular basis to determine if the risk areas have changed, if the criteria for judging solutions have changed, and if the planned prototypes and studies still address the risk areas effectively. The proposal information maintained in the prototype tracking database is updated accordingly.

The Prototype Lead is responsible for managing the day-to-day tasks associated with the prototype. This includes assigning tasks to personnel, keeping a schedule, and ensuring that the prototype effort remains focused on the defined objectives and purpose. The Prototype Lead will also keep the applicable DTR advised of any problems encountered that may impact the cost, schedule or success of the prototype. The Prototype Lead provides quarterly Prototype Status Reports in conformance of DID 318/DV3.

Criteria have been established to judge both the efficacy of a prototype or study, and the reasonableness of implementing the solution indicated by its results. These criteria are:

- Success Criteria: Did the results of the prototype or study satisfy the criteria identified in the proposal?

- Cost Containment: Is the proposed solution cost-effective over the projected life cycle?

- Evolveability: Is the proposed solution amenable to future changes in the configuration or design of the ECS or of technology? Is the solution subject to scaling in the event that performance requirements are changed?

- Manageability: Does the proposed solution support the ECS evolutionary development cycle and the multi-track development approach?

- Architecture Conformance: Does implementation of the prototype result fit into the existing ECS architecture?

- Performance to Requirements: Does the proposed solution maintain or ease adherence to requirements?

- Site Autonomy: Does the proposed solution require each DAAC to be unduly dependent on the other DAACs?

5.6.1 Advanced Prototype and Studies Execution/Evaluation

Evaluation of advanced prototypes will be performed by Prototype Evaluation Teams.   In some cases, independent teams may be established to provide an independent evaluation. These teams may include users from the science community. The level of independent teams and user participation will be determined at prototype initiation. These prototypes will be demonstrated at the PRRs as part of the evaluation process. Where feasible, on-line evaluations will be performed. Reports, white papers, demonstrations and CDRLs will be used to document the results of the advanced prototypes and studies.

Advanced prototypes, in some cases, will be *throw-aways* if the evaluation proves that the proposed changes impact design or development in a manner that cannot be incorporated given the cost and schedule profile of the ECS. However, lessons learned from these efforts still provide a valuable contribution to the development of the ECS.

5.6.2 Engineering Prototype and Studies Execution/Evaluation

Evaluation of engineering prototypes and studies will be performed by the DTR. Status of the engineering prototype efforts will be maintained by the Prototype Lead and forwarded to the DTR and Prototype Administrator. The segment managers and ETMs control the level of status monitoring, demonstrations, and user participation in the evaluation process. User involvement will be through demonstrations and inclusion into evaluation packages where appropriate. In some cases, the ECS Development Facility (EDF) will provide an on-line evaluation capability. A summary of these prototype efforts will be maintained in the Prototype and Studies Progress Reports (DID 318/DV3) and will be available in electronic format via the EDHS.

5.6.3 Technology Analysis Prototype and Studies Execution/Evaluation

Evaluation of technology analysis prototypes and studies will be performed by the DTR. Status of the technology analysis prototype efforts will be maintained by the Prototype Lead and forwarded to the DTR and Prototype Administrator. Prototype Results Reviews and other demonstrations are at the discretion of the ETM. A summary of these prototype efforts will be maintained in the Prototype and Studies Progress Reports (DID 318/DV3) and will be available in electronic format via the EDHS. The segment managers and ETMs control the level of status, demonstrations, and user participation in the evaluation process. User involvement will be through evaluation packages where appropriate.

5.7   Incorporation

The Development Team Representative and Evaluation Team Leader will use several methods to incorporate results from prototyping and studies efforts back into the design and development process. The method used depends upon what type of prototype is involved. It is highly desirable that prototypes support easy integration into Evaluation Packages (EPs) and conform to the ECS baseline architecture. This is the most efficient method of working prototype and study results into the formal and incremental development track. In all cases, participation by members of the segment development teams in all prototypes and studies ensures a quick feedback path into the ECS Segment design and development process.

For all classes of prototypes and studies, if the prototype or study was conducted as a mitigation plan driven by an ECS project risk item, the results will be reviewed to determine if the risk factor should be changed. Possible outcomes include initiating further prototypes or studies, or if a favorable result is activated, the risk item may be retired.

5.7.1 Advanced Prototypes and Studies

Proposed new requirements resulting from advanced prototypes will be entered into the Recommended Requirements Database (RRDB) for formal evaluation by the ECS project via the RRDB technical assessment process. Approved recommendations are forwarded to the ECS Change Control Board (CCB) via a Configuration Change Request (CCR). Results from some advanced prototypes will be documented in contract deliverables, reports, and demonstrations.

5.7.2 Engineering Prototypes and Studies

Potential impacts to the ECS design resulting from engineering prototypes will be reported at the Preliminary Design Review (PDR) or the Incremental Design Review (IDR) for each release. Thus the results of these prototypes and studies will be considered prior to a final decision to proceed with the detailed design. White Papers will be used to document and distribute results to the ECS community prior to the PDR and IDRs and will be available via the EDHS. If software code or prototype hardware from an engineering prototype effort is going to be used in the ECS implementation, a complete set of required documentation and testing must be accomplished to support the requirements of the incremental or formal development track.

5.7.3 Technology Analysis Prototypes and Studies

Technology Analysis prototype and study impacts to the ECS design will be reported at the Release Initiation Reviews (RIRs), PDRs, and IDRs. Thus the results of these prototypes and studies are also considered prior to final decision to proceed with the detailed design. White papers are also used here as a means to document and distribute results to the ECS community prior to formal reviews. If a design change resulting from an engineering prototype effort is adopted, a complete set of required design documentation must be prepared to support the requirements of the incremental or formal development track.

Appendix A. Prototypes & Studies in Progress

Task Name	Applicable Segments	Prototype/ Study Class	Description
Version 0 Analysis Study	CSMS FOS SDPS	Advanced	Evaluate concepts and lessons learned from Version 0 for incorporation into the ECS.
User Model and Profile Study	Science Office	Engineering	Study and refine the ECS user model and user profile, and the effect of an expanded non-science user community of the ECS.
Buffer Storage Requirements	SDPS	Engineering	Evaluate temporary storage architecture for the short-term storage of standard products.
Spatial Data Access Prototypes	SDPS	Engineering	Evaluate methods of interoperable and efficient spatial searching of metadata.
IST Prototype	FOS	Engineering	Refine the operational concept and requirements for the IST.
Planning and Scheduling Prototype	FOS	Engineering	Drive out requirements for mission planning and scheduling operational concepts, and mitigate risks associated with User Needs/Requirements Uncertainty.
Command Management Prototype	FOS	Engineering	Refine requirements for safe commanding of the spacecraft and instruments.
File Manager Study	SDPS	Technology	Perform a trade study of available file storage management systems.
Evaluate Archive Media/Recorders	SDPS	Technology	Test candidate archive media choices.
Evaluate Archive Robotics	SDPS	Technology	Integrate and test candidate archive robotics choices.
DCE/DME Migration Strategies Task	CSMS	Engineering	Development of strategies for ECS transition to the OSF DCE/DME architecture model. Infrastructure COTS characterization
DCE/DME Products Survey Task	CSMS	Technology	Analysis of current and emerging "plug-in" applications for the DCE/DME model within the CSMS design. COTS survey.

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Appendix B. Prototype & Studies Proposal/Status Form

PROTOTYPE STATUS REPORT

Title:	

Type: (check one)	Category:	Status:

Purpose:	

Objective:	

Approach:	

Evaluation Method:	

Key Risks Addressed:	

Results:	

Documents:	

Effort:		Funding:

Other Significant Costs:	

Principle Investigator:	Lead:	Development Team Leader:

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Abbreviations and Acronyms

ADC   Affiliated Data Center

CCB   Configuration Control Board

CCR   Configuration Change Request

CDRL   Contract Data Requirement List

CO   Contracting Officer

COTR   Contracting Office Technical Representative

COTS   Commercial off-the-shelf

CSMS   Communication and System Management Segment

DAAC   Distributed Active Archive Centers

DADS   Data Archive and Distribution System

DCE   Distributed Computer Environment

DCN   Document Change Notice

DID   Data Item Description

DME   distributed management environment

DTR   Development Team Representative

ECOM   EOS Communications

ECS   EOSDIS Core System

EDF   ECS Development Facility

EDHS   ECS Data Handling System

EOC   EOS Operations Center

EOS   Earth Observing System

EOSDIS   EOS Data and Information System

EP   Evaluation Package

EPDS   Earth Probe Data System

ESN   EOSDIS Science Network

ETM   ECS Technical Manager

FOS   Flight Operations Segment

FSMS   File Storage Management System

GSFC	Goddard Space Flight Center
ICC	Instrument Control Center
ICD	Interface Control Document
IDR	Incremental Design Review
IMS	Information Management System
IP	Internet Protocol
IST	Instrument Support Terminals
LAN	local area network
LSM	local system management
NASA	National Aeronautics and Space Administration
NSI	NASA Science Internet
PDR	Preliminary Design Review
PGS	Product Generation System
PRR	Prototype Results Review
RAID	Redundant Array of Inexpensive Disks
RIR	Release Initiation Review
RRDB	Recommended Requirements Database
RRR	Release Readiness Review
SCF	Science Computing Facility
SDPS	Science Data Processing Segment
SDR	System Design Review
SMC	System Management Center
SRR	System Requirements Review
STL	Science Technology Laboratory
TRMM	Tropical Rainfall Measuring Mission
TRR	Test Readiness Review
WAN	wide area network
WBS	Work Breakdown Structure